

# INTERNATIONAL STANDARD

**ISO**  
**9328-4**

First edition  
1991-12-01

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## Steel plates and strips for pressure purposes — Technical delivery conditions —

### Part 4:

Weldable fine grain steels with high proof stress  
supplied in the normalized or quenched and  
tempered condition

ISO 9328-4:1991

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*Tôles et bandes en acier pour service sous pression — Conditions  
techniques de livraison —*

*Partie 4: Aciers à grains fins soudables à valeur élevée de limite  
conventionnelle d'élasticité, livrés à l'état normalisé ou trempé et revenu*

INTERNATIONAL

ISO



Reference number:  
ISO 9328-4:1991(E)

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9328-4 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 10, *Steel for pressure purposes*.

Parts 1 to 5 of ISO 9328 cancel and replace the first editions of ISO 2604-4:1975, ISO/TR 2604-7:1986 and ISO 2604-8:1985, of which they constitute a technical revision.

ISO 9328 consists of the following parts, under the general title *Steel plates and strips for pressure purposes — Technical delivery conditions*:

- *Part 1: General requirements*
- *Part 2: Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties*
- *Part 3: Nickel-alloyed steels with specified low temperature properties*
- *Part 4: Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition*
- *Part 5: Austenitic steels*

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International Organization for Standardization  
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

# Steel plates and strips for pressure purposes — Technical delivery conditions —

## Part 4:

Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition

### 1 Scope

**1.1** This part of ISO 9328 applies to plates of 3 mm to 70 mm thickness and strip of thickness greater than or equal to 3 mm, manufactured of the normalized fine grain steels (see note) covered in table 1A or the quenched and tempered fine grain steels covered in table 1B (see note 3 to 1.1 of ISO 9328-1) and to be delivered according to the specifications given in ISO 9328-1.

The steels are classified into

- room temperature grades (P... TN or P... TQ);
- elevated temperature grades (PH... TN or PH... TQ);
- low temperature grades (PL... TN or PL... TQ);
- low and elevated temperature grades (PLH... TN or PLH... TQ).

**NOTE 1** Fine grain steels means steels with grain size 6 or finer according to the grain size charts in ISO 643.

**1.2** This part of ISO 9328 covers the following data:

- a) in tables 1A and 1B the limits for
  - the chemical composition according to the cast analysis,
  - the tensile properties at room temperature;

b) in table 2 the permissible deviations of the results of the product analysis from the specified limits for the cast analysis;

c) in table 3 the minimum impact properties;

d) in table 4 the minimum elevated temperature proof stress values.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9328. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9328 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 148:1983, *Steel — Charpy impact test (V-notch)*.

ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size*.

ISO 9328-1:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 1: General requirements*.

### 3 Definitions

See ISO 9328-1.

#### **4 Ordering and designation**

See ISO 9328-1.

#### **5 Requirements**

See ISO 9328-1 and tables 1 to 4.

#### **6 Inspection, testing and conformity of products**

See ISO 9328-1.

#### **7 Marking**

See ISO 9328-1.

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**Table 1A — Chemical composition (cast analysis), room temperature mechanical properties and heat-treatment conditions of the normalized fine grain steels**

Line No.	Steel type designation <sup>1)</sup>	Chemical composition [% (m/m)] <sup>2)</sup>													
		C max.	Si	Mn <sup>5)</sup>	P max.	S max.	Al <sup>total</sup> min. <sup>6)</sup>	Cr max.	Cu max.	Mo max.	N max.	Nb <sup>6)</sup> max.	Ni max.	Ti <sup>6)</sup> max.	V <sup>6)</sup> max.
1	P255 TN, PH255 TN	0,17	0,10 to 0,35	0,50 to 1,40	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>8)</sub>	0,30 <sub>8)</sub>	0,08 <sub>8)</sub>	0,020	0,05 <sub>9)</sub>	0,30	0,03 <sub>9)</sub>	0,05 <sub>9)</sub>
	PL255 TN	0,15			0,030	0,030									
2	P285 TN, PH285 TN	0,18	0,10 to 0,40	0,50 to 1,40	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>8)</sub>	0,30 <sub>8)</sub>	0,08 <sub>8)</sub>	0,020	0,05 <sub>9)</sub>	0,30	0,03 <sub>9)</sub>	0,05 <sub>9)</sub>
	PL285 TN	0,16			0,030	0,030									
3	P315 TN, PH315 TN	0,18	0,10 to 0,40	0,70 to 1,50	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>8)</sub>	0,30 <sub>8)</sub>	0,08 <sub>8)</sub>	0,020	0,05 <sub>9)</sub>	0,30	0,03 <sub>9)</sub>	0,05 <sub>9)</sub>
	PL315 TN	0,16			0,030	0,030									
4	P355 TN, PH355 TN	0,20	0,10 to 0,50	0,90 to 1,7	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>8)</sub>	0,30 <sub>8)</sub>	0,08 <sub>8)</sub>	0,020	0,05 <sub>10)</sub>	0,30 <sub>12)</sub>	0,03 <sub>10), 13)</sub>	0,10 <sub>10)</sub>
	PL355 TN, PLH355 TN	0,18			0,030	0,030									
5	P390 TN, PH390 TN	0,20	0,10 to 0,60	1,0 to 1,7	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>8)</sub>	0,30 <sub>8)</sub>	0,08 <sub>8)</sub>	0,020	0,05 <sub>11)</sub>	1,00	0,20 <sub>11)</sub>	0,20 <sub>11)</sub>
	PL390 TN, PLH390 TN				0,030	0,030									
6	P420 TN, PH420 TN	0,20	0,10 to 0,60	1,0 to 1,7	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>16)</sub>	0,10	0,020	0,05 <sub>11)</sub>	1,00	0,20 <sub>11)</sub>	0,20 <sub>11)</sub>	
	PL420 TN, PLH420 TN				0,030	0,030									
7	P460 TN, PH460 TN	0,20 <sub>17)</sub>	0,10 to 0,60	1,0 to 1,7	0,035	0,035	0,020 <sub>7)</sub>	0,30 <sub>16)</sub>	0,10	0,020 <sub>17)</sub>	0,05 <sub>11)</sub>	1,00	0,20 <sub>11)</sub>	0,20 <sub>11)</sub>	
	PL460 TN, PLH460 TN				0,030	0,030									

Tensile properties at room temperature <sup>3)</sup>				Impact properties See table	Elevated temperature properties See table	Heat-treatment		Cooling conditions
Thickness mm	$R_e$ min. N/mm <sup>2</sup>	$R_m$ N/mm <sup>2</sup>	$A$ min. %			Usual reference heat-treatment conditions	Austenitizing temperature °C	
< 35	255	360 to 480	25	3	4	N	880 to 960	Air
> 35 < 50	245							
> 50 < 70	235							
< 35	285	390 to 510	24	3	4	N	880 to 960	Air
> 35 < 50	275							
> 50 < 70	265							
< 35	315	440 to 560	23	3	4	N	880 to 960	Air
> 35 < 50	305							
> 50 < 70	295							
< 35	355	490 to 610	22	3	4	N( + T) 14), 15)	880 to 960	Air
> 35 < 50	345							
> 50 < 70	325							
< 16	390	510 to 650	20	3	4	N( + T) 14), 15)	880 to 960	Air
> 16 < 35	380							
> 35 < 50	370							
> 50 < 70	350							
< 16	420	540 to 680	19	3	4	N( + T) 14), 15)	880 to 960	Air
> 16 < 35	410							
> 35 < 50	400							
> 50 < 70	380							
< 16	460	570 to 720 18)	17	3	4	N( + T) 14), 15)	880 to 960	Air
> 16 < 35	450							
> 35 < 50	440							
> 50 < 70	420							

**Footnotes to table 1A**

- 1) All data on designations in this part of ISO 9328 are to be regarded as preliminary and will be revised as soon as a general system for the designation of steels and steel products has been established.
- 2) See ISO 9328-1, 5.2.2.
- 3)  $R_o$ : yield stress (see ISO 9328-1, table 3, footnote 4);  
 $R_m$ : tensile strength;  
 $A$ : percentage elongation after fracture on original gauge length  $L_o = 5,65 \sqrt{S_o}$  (where  $S_o$  is the original cross-sectional area).
- 4) N: normalized;  
N( + T): normalized and, if appropriate, tempered.
- 5) For products 6 mm thick or less, the minimum Mn content may be reduced by 0,2 % (m/m).
- 6) Grain-refining elements (Al, Nb, Ti, V) must be added to the steel either single or in combination to obtain the fine grain structure as defined in the note to 1.1 and to respect the properties specified in this part of ISO 9328.
- 7) The Al-content of more than or equal to 0,020 % (m/m) is valid if only Al is applied.
- 8) The sum of percentages of Cr + Cu + Mo shall not exceed 0,45 % (m/m).
- 9) The sum of percentages of Nb + Ti + V shall not exceed 0,05 % (m/m).
- 10) The sum of percentages of Nb + Ti + V shall not exceed 0,12 % (m/m).
- 11) The sum of percentages of Nb + Ti + V shall not exceed 0,22 % (m/m).
- 12) Maximum 0,85 % (m/m) Ni, if added as an alloying element.
- 13) For special cold-forming applications, a maximum value of 0,08 % (m/m) Ti may be applied.
- 14) See also ISO 9328-1, 5.1.3.
- 15) It should be taken into account that in the case of hot-forming, the properties can be adversely affected (see ISO 9328-1, 5.1.3.2).
- 16) Maximum 0,70 % (m/m) Cu, if added as an alloying element.
- 17) By agreement, the maximum carbon content may be increased to 0,22 % (m/m) and the maximum nitrogen content to 0,030 % (m/m) provided that the level of the elements Cr, Cu, Mo and Ni does not exceed the maximum levels specified for P 355 TN.
- 18) For thicknesses up to 16 mm, an upper limit of 730 N/mm<sup>2</sup> must be tolerated.

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